

Amendment & Response

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Applicant(s): Brian A. VAARTSTRA

Serial No. 10/032,049

Confirmation No.: 5131

Filed: 21 December 2001

For: METHODS FOR PLANARIZATION OF METAL-CONTAINING SURFACES USING HALOGENS AND
HALIDE SALTS

Remarks

The Office Action mailed July 3, 2002, has been received and reviewed. Claims 1, 18, 31, 34, 37, and 50 having been amended, and claims 51-53 having been added, the pending claims are claims 1-53.

Claims 1, 18, 31, 34, 37, and 50 have been amended to recite that the planarization composition comprises a halogen-containing compound and a halide salt, which are separately delivered. Support for these amendments may be found in the specification at page 5, lines 14-15.

Support for new claims 51-53 may be found, for example in the claims as filed and in the specification at page 4, lines 14-16, page 5, lines 14-15, page 11, lines 1-2, and the Example at page 15, line 28 to page 16, line 13.

No new matter has been added as a result of the above amendments.

Reconsideration and withdrawal of the rejections, in view of the above amendments and the following comments, are respectfully requested

The 35 U.S.C. §112 Rejection

The Examiner rejected claim 9 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Examiner found the phrase in claim 9 "carried out in one step" unclear. Applicant respectfully traverses this rejection.

At page 14, lines 23-26, it is disclosed that "preferably, the planarization process is carried out in one cycle (i.e., one step). That is, for the removal of any material from a particular surface, there is only one planarization cycle without any intervening rinse cycles." Applicant respectfully submits that one of skill in the art would understand from the specification that claim 9 recites the method of claim 1 wherein there is only one planarization cycle, without any intervening rinse cycles.

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Reconsideration and withdrawal of the rejection is respectfully requested.

The 35 U.S.C. §102 Rejection

The Examiner rejected claims 1-32, 34-35, 37-47, and 49-50 under 35 U.S.C. §102(e) as being anticipated by Evans (U.S. Patent No. 6,290,736). Applicant respectfully traverses this rejection.

Applicant's claims 1-50 recite planarization methods including a planarization composition wherein the planarization composition includes a halogen-containing compound and a halide salt. In each of these claims it is recited that the halogen-containing compound and the halide salt are separately delivered. Evans et al., on the other hand, neither teach nor suggest a planarization composition including a halogen-containing compound and a halide salt that are separately delivered. Rather, as suggested by the Examiner at page 3, lines 8-11, any halide salt that may be present is formed in situ, that is present as a result of a halogen and a strongly basic aqueous solution such as NaOH or KOH reacting to form halide metal salt.

Applicant, therefore, submits that Evans et al. neither teach nor suggest Applicant's pending claims. Reconsideration and withdrawal of the rejection is respectfully requested.

The 35 U.S.C. §103 Rejection

The Examiner rejected claims 33, 36, and 48 under 35 U.S.C. §103(a) as being unpatentable over Evans et al. (U.S. Patent No. 6,290,736). Applicant respectfully traverses this rejection.

As indicated above, Applicant respectfully submits that Evans et al. neither teach nor suggest the invention as claimed. Furthermore, Applicant respectfully submits that there is nothing that would suggest to one of skill in the art to modify Evans et al. to provide Applicant's claimed invention.

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The present claims to planarization methods including planarization compositions including a halogen-containing compound and a halide salt wherein the halogen-containing compound and the halide salt are separately delivered (claims 1, 18, 31, 34, 37, and 50). This advantageously provides flexibility in the selection of components for the planarization composition and variety in the resulting composition. For instance, separate delivery of the halogen-containing composition and halide salt provides planarization compositions that may include more than one type of halogen. This provides a greater variety of compositions available as planarization compositions than compositions including only one type of halogen. Such variety in composition selection may, for instance, enhance planarization.

Furthermore, Applicant's invention as claimed provides flexibility in determining the halide salt concentration in the planarization composition. As the halogen-containing compound and the halide salt of the present invention as claimed in claims 33, 36, and 48 are separately delivered, the concentration of the halide salt present is not dependent upon the concentration of the halogen-containing compound. In contrast, any concentration of halide salt that may be present in the slurries of Evans et al., if present, is dependent on the amount of the halogen and the base provided.

Applicant submits that Evans et al. neither teach nor suggest Applicant's claimed invention. Furthermore, as, for instance, Evans et al. also fail to indicate the flexibility that may be provided by the planarization compositions included in Applicant's claims, Applicant also submits that there is no motivation to modify Evans et al. to provide Applicant's invention as claimed.

Reconsideration and withdrawal of the rejection is, therefore, respectfully requested.

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The New Claims

Additionally, in a preferred embodiment of Applicant's invention, a planarization method is provided that includes a planarization composition wherein the planarization composition is not basic (claim 53). Non-basic planarization compositions are typically preferred to prevent damage to underlying substrate layers during planarization of the type that can occur with the use of basic compositions.

Evans et al., on the other hand, include a slurry including a strongly basic aqueous solution. Applicant respectfully submits, therefore, that Evans et al. teach away from Applicant's invention as recited in claim 53.

Furthermore, in another preferred embodiment of Applicant's invention, a planarization method is provided that includes a planarization composition wherein the planarization composition includes a halide salt and a halogen-containing compound with a halogen that is different than the halogen of the halide salt (claim 52).

Evans et al., conversely, disclose a slurry that includes a single halogen in the composition. The slurry includes "an elemental halogen in a strongly basic aqueous solution as the chemical agent, in addition to an abrasive. The elemental halogen may be either bromine, iodine, or chlorine" (Evans et al., column 2, lines 30-33, emphasis added). Because any halide salt present would be formed in situ from the halogen or halogen-containing compound and the strongly basic solution, and there is no disclosure of using a combination of different halogen-containing compounds, Evans et al. neither teach nor suggest a planarization composition including a halogen-containing compound and a halide salt wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt, as recited in present claim 52.

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Prior Art Made of Record and Not Relied Upon

Applicant's Representatives note the art made of record but not relied upon:

U.S. Patent No. 6,395,194 B1 issued May 28, 2002 to Russell et al.

U.S. Patent No. 5,976,928 issued November 2, 1999 to Kirlin et al.

U.S. Patent No. 6,346,741 B1 issued February 12, 2002 to Van Buskirk et al.

Applicant's Representatives point out that U.S. Patent Nos. 6,395,194 B1 and 6,346,741 B1 both issued after the filing date of the present application. Furthermore, Applicant's Representatives submit that none of the above documents teach or suggest Applicant's claimed invention including a halogen-containing compound and a halide salt.

Summary

It is respectfully submitted that the pending claims 1-53 are in condition for allowance and notification to that effect is respectfully requested.

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The Examiner is invited to contact Applicant's Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for

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CERTIFICATE UNDER 37 CFR §1.10:

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The undersigned hereby certifies that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

By: 

Name: KATHLEEN L. FRANKLIN



**APPENDIX A - SPECIFICATION/CLAIM AMENDMENTS
INCLUDING NOTATIONS TO INDICATE CHANGES MADE**

Serial No.: 10/032,049

Docket No.: 150.0118 0101

Amendments to the following are indicated by underlining what has been added and bracketing what has been deleted. Additionally, all amendments have been indicated in boldface type.

In the Claims

For convenience, all pending claims are shown below.

1. (AMENDED) A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIIB metal, a Group IB metal, and a combination thereof;

supplying a planarization composition in proximity to the interface; and
planarizing the substrate surface;

wherein the planarization composition comprises a halogen-containing compound and a halide salt, **which are separately delivered.**

2. The method of claim 1 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of a Group VIIIIB metal, a Group IB metal, and a combination thereof, which is in elemental form or an alloy thereof.
3. The method of claim 1 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of a Group VIIIIB second row metal, a Group VIIIIB third row metal, a Group IB second row metal, a Group IB third row metal, and a combination thereof.
4. The method of claim 3 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of Rh, Pd, Pt, Ir, and Ru.

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5. The method of claim 4 wherein the metal-containing surface comprises elemental platinum.
6. The method of claim 1 wherein the metal is present in an amount of about 50 atomic percent or more.
7. The method of claim 1 wherein the substrate is a semiconductor substrate or substrate assembly.
8. The method of claim 1 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
9. The method of claim 1 which is carried out in one step.
10. The method of claim 1 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
11. The method of claim 10 wherein the halogen-containing compound is selected from the group consisting of F_2 , Cl_2 , Br_2 , I_2 , $ClBr$, IBr , ICl , BrF , ClF , ClF_3 , BrF_3 , ClF_5 , IF_5 , IF_7 , XeF_2 , HgF_2 , SF_4 , alkyl halides, and complexes of X_2 with organic bases, and combinations thereof.
12. The method of claim 1 wherein the halide salt is an inorganic salt.

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13. The method of claim 12 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr, NH_4F , and combinations thereof.
14. The method of claim 1 wherein the halide salt is an organic salt.
15. The method of claim 14 wherein the organic salt is selected from the group consisting of Et_4NBr , Me_3NHCl , Me_4NF , and combinations thereof.
16. The method of claim 1 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
17. The method of claim 1 wherein the polishing surface comprises a fixed abrasive article.
18. (AMENDED) A planarization method comprising:
 - providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;
 - providing a polishing surface;
 - providing a planarization composition at an interface between the at least one region of platinum-containing surface and the polishing surface; and
 - planarizing the at least one region of platinum-containing surface;
 - wherein the planarization composition comprises a halogen-containing compound and a halide salt, **which are separately delivered**.
19. The method of claim 18 wherein the platinum-containing surface of the substrate

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comprises platinum in elemental form.

20. The method of claim 18 wherein the platinum is present in an amount of about 50 atomic percent or more.
21. The method of claim 18 wherein the semiconductor substrate or substrate assembly is a silicon wafer.
22. The method of claim 18 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
23. The method of claim 18 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
24. The method of claim 23 wherein the halogen-containing compound is selected from the group consisting of F_2 , Cl_2 , Br_2 , I_2 , $ClBr$, IBr , ICl , BrF , ClF , ClF_3 , BrF_3 , ClF_5 , IF_5 , IF_7 , XeF_2 , HgF_2 , SF_4 , alkyl halides, and complexes of X_2 with organic bases, and combinations thereof.
25. The method of claim 18 wherein the halide salt is an inorganic salt.
26. The method of claim 25 wherein the inorganic halide salt is selected from the group consisting of NaI , KCl , KBr , NH_4F and combinations thereof.
27. The method of claim 18 wherein the halide salt is an organic salt.

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28. The method of claim 27 wherein the organic salt is selected from the group consisting of Et₄NBr, Me₃NHCl, Me₄NF, and combinations thereof.
29. The method of claim 18 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
30. The method of claim 18 wherein the polishing surface comprises a fixed abrasive article.
31. (AMENDED) A planarization method comprising:
- positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;
 - supplying a planarization composition in proximity to the interface; and
 - planarizing the substrate surface;
- wherein the planarization composition comprises:
- a halogen-containing compound selected from the group consisting of F₂, Cl₂, Br₂, I₂, ClBr, IBr, ICl, BrF, ClF, ClF₃, BrF₃, ClF₅, IF₅, IF₇, XeF₂, HgF₂, SF₄, alkyl halides, and complexes of X₂ with organic bases, and combinations thereof; and
 - a halide salt selected from the group consisting of NaI, KCl, KBr, NH₄F, Et₄NBr, Me₃NHCl, Me₄NF, and combinations thereof;
- wherein the halogen-containing compound and the halide salt**

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are separately delivered.

32. The method of claim 31 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.

33. The method of claim 31 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.

34. (AMENDED) A planarization method comprising:

providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;

providing a polishing surface;

providing a planarization composition at an interface between the at least one region of platinum-containing surface and the polishing surface; and

planarizing the at least one region of platinum-containing surface;

wherein the planarization composition comprises:

a halogen-containing compound selected from the group consisting of F_2 , Cl_2 , Br_2 , I_2 , $ClBr$, IBr , ICl , BrF , ClF , ClF_3 , BrF_3 , ClF_5 , IF_5 , IF_7 , XeF_2 , HgF_2 , SF_4 , alkyl halides, and complexes of X_2 with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of NaI , KCl , KBr , NH_4F , Et_4NBr , Me_3NHCl , Me_4NF , and combinations thereof;

**wherein the halogen-containing compound and the halide salt
are separately delivered.**

35. The method of claim 34 wherein the halogen-containing compound is present in the

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planarization composition in an amount of about 1% to about 10% by weight.

36. The method of claim 34 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.

37. (AMENDED) A planarization method for use in forming an interconnect, the method comprising:

providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

positioning a first portion of a polishing surface for contact with the metal-containing layer;

providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and

planarizing the metal-containing layer;

wherein the planarization composition comprises a halogen-containing compound and a halide salt, **which are separately delivered.**

38. The method of claim 37 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.

39. The method of claim 37 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.

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40. The method of claim 39 wherein the halogen-containing compound is selected from the group consisting of F_2 , Cl_2 , Br_2 , I_2 , $ClBr$, IBr , ICl , BrF , ClF , ClF_3 , BrF_3 , ClF_5 , IF_5 , IF_7 , XeF_2 , HgF_2 , SF_4 , alkyl halides, and complexes of X_2 with organic bases, and combinations thereof.
41. The method of claim 37 wherein the halide salt is an inorganic salt.
42. The method of claim 41 wherein the inorganic halide salt is selected from the group consisting of NaI , KCl , KBr , NH_4F and combinations thereof.
43. The method of claim 37 wherein the halide salt is an organic salt.
44. The method of claim 43 wherein the organic salt is selected from the group consisting of Et_4NBr , Me_3NHCl , Me_4NF , and combinations thereof.
45. The method of claim 37 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight.
46. The method of claim 45 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
47. The method of claim 37 wherein the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
48. The method of claim 47 wherein the halide salt is present in the planarization

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composition in an amount of about 1% to about 10% by weight.

49. The method of claim 37 wherein the polishing surface comprises a fixed abrasive article.

50. (AMENDED) A planarization method for use in forming an interconnect, the method comprising:

providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

positioning a first portion of a polishing surface for contact with the metal-containing layer;

providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and

planarizing the metal-containing layer;

wherein the planarization composition comprises:

a halogen-containing compound selected from the group consisting of F_2 , Cl_2 , Br_2 , I_2 , $ClBr$, IBr , ICl , BrF , ClF , ClF_3 , BrF_3 , ClF_5 , IF_5 , IF_7 , XeF_2 , HgF_2 , SF_4 , alkyl halides, and complexes of X_2 with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of NaI , KCl , KBr , NH_4F , Et_4NBr , Me_3NHCl , Me_4NF , and combinations thereof;

wherein the halogen-containing compound and the halide salt are separately delivered.

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51. (NEW) A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

supplying a planarization composition in proximity to the interface;

and

planarizing the substrate surface;

wherein the planarization composition comprises:

a halogen-containing compound selected from the group consisting of ClBr, IBr, ICl, BrF, ClF, ClF₃, BrF₃, ClF₅, IF₅, IF₇, XeF₂, HgF₂, SF₄, alkyl halides, and complexes of X₂ with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of NaI, KCl, KBr, NH₄F, Et₄NBr, Me₃NHCl, Me₄NF, and combinations thereof;

wherein the halogen-containing compound and the halide salt are separately delivered.

52. (NEW) A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

supplying a planarization composition in proximity to the interface; and

planarizing the substrate surface;

wherein the planarization composition comprises a halogen-containing

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compound and a halide salt, and further wherein the halogen of the halogen-
containing compound is different than the halogen of the halide salt.

53. (NEW) A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a
polishing surface, wherein the metal-containing surface comprises a metal selected
from the group consisting of a Group VIIIB metal, a Group IB metal, and a
combination thereof;

supplying a planarization composition in proximity to the interface; and
planarizing the substrate surface;

wherein the planarization composition comprises a halogen-containing
compound and a halide salt, and further wherein the planarization composition is
not basic.